15772

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JOEL SCHMITIGAL

Near-Infrared Fuel Analysis

SUPERIOR TECHNOLOGY

FOR A

SUPERIOR ARMY

RDECOM

ZACOM

TARDEC

U.S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Report Documentation Page

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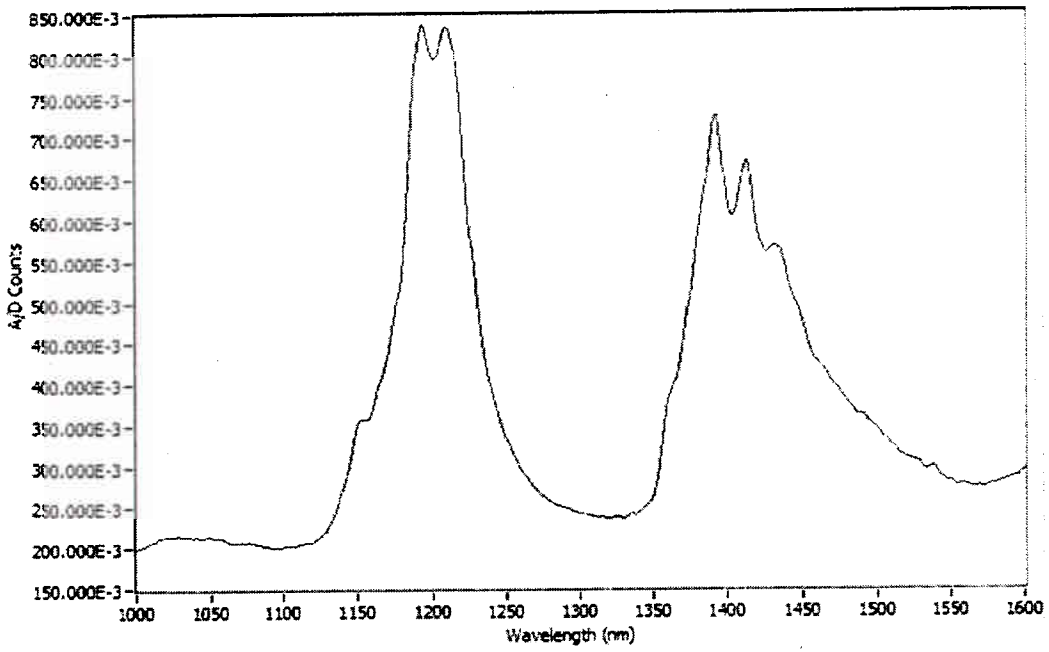
Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

METHODOLOGY

- Portable, Ruggedized, Near Infrared Spectrometer
- Chemometrics using Principal Component Analysis and Partial Least Squares or Soft Independent Modeling of Class Analogies Method (SIMCA)
- Manufactured by Micron Optical Systems Inc.
  - Suffolk, VA

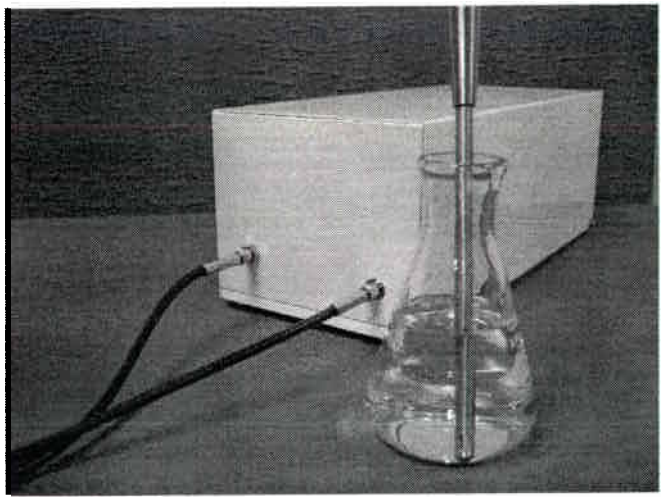
• Army Small Business Innovative Research (SBIR)
  - Phase II awarded 1/11/2001



SPECTROMETER CONFIGURATION

Size
- 4.25" x 5.25" x 11.75"

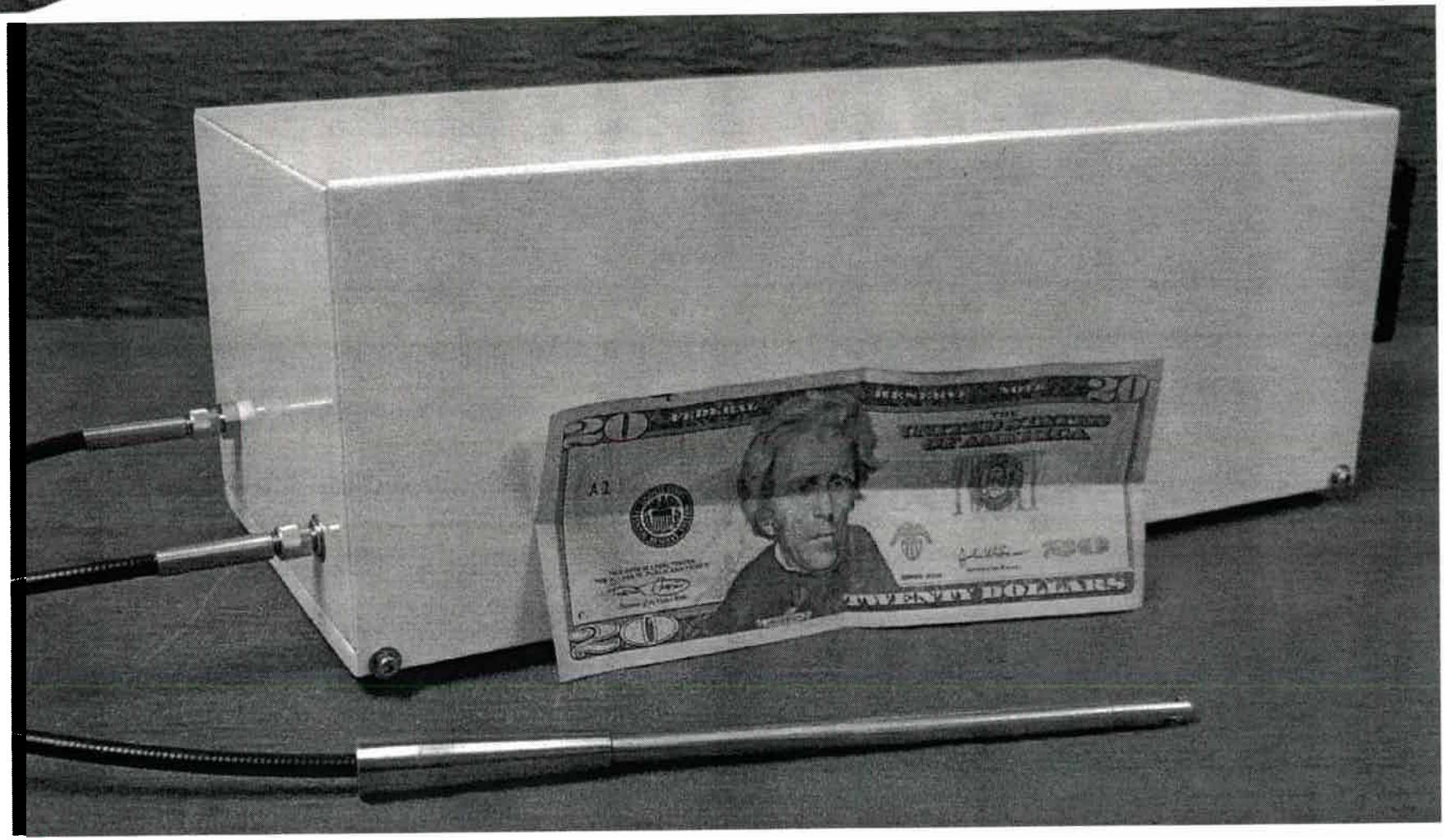
Detector
- Substrate: InGaAs one dimensional array
- Pixels: 512 pixels
- Electronic Shutter: Integration from 1 ms to minutes
- Readout and Display Update: 50 specta / second



Spectrograph
- Grating: Volume Holographic transmission grating
- Spectral Range: 1000-1600 nm
- Spectral Dispersion: 1.56 or 0.98 nm/pixel

Source
- Feedback-Stabilized High-Intensity tungsten halide lamp with peak intensity at 1100nm.

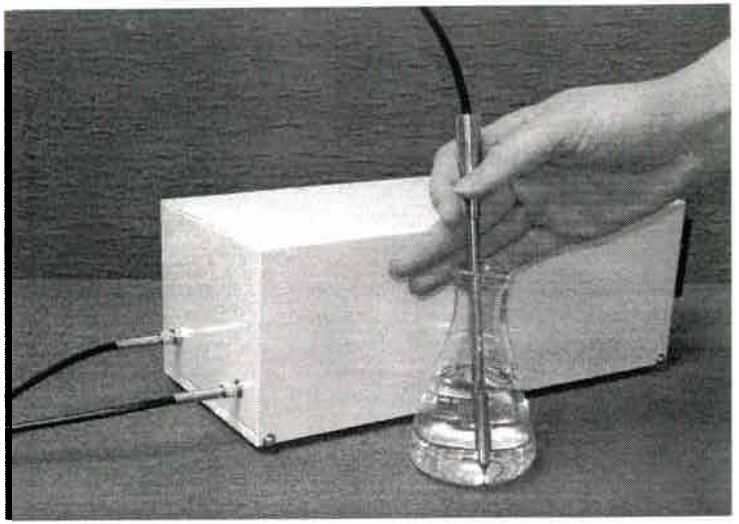
SPECTROMETER CONFIGURATION



ADVANTAGES AND LIMITATIONS

ADVANTAGES

- Small Size : 4.25" x 5.25" x 11.75"
- Light Weight
- Adaptable fiber optic probe
- Easy to use
- Fast Analysis: Results in less than 1s
- No hazardous waste generated



LIMITATIONS

- Correlative measurement: the accuracy of your results are dependant on the accuracy of the ASTM data used to build the models

- Correlation to properties dependent on molecular structure

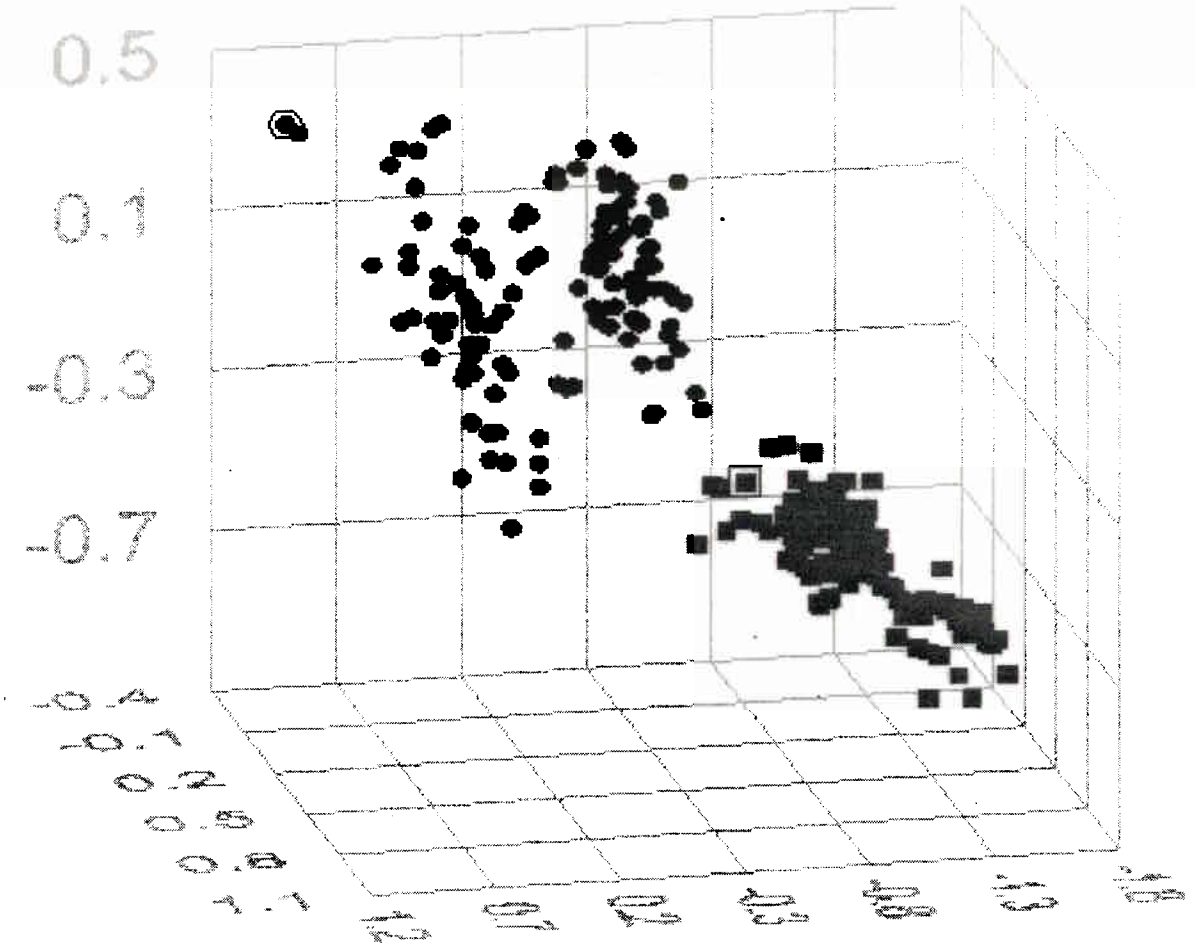
- Range/Quantity of fuel samples

- Sensitivity directly related to composition of fuel

FUEL PROPERTIES MODELED

Property	ASTM Method	ASTM Reproducibility	SEV
Boiling point at 10% dist	D 86	3.74 - 12.02 °C	8.35 °C
Boiling point at 90% dist	D 86	3.74-10.52 °C	9.40 °C
Dist End Point	D 86	10.5 °C	12.87 °C
Density	D 1298	0.0012 g/mL	0.0041 g/mL
API Gravity	D 1298	0.3	0.9384
Flashpoint	D 93	6 °C	5.141 °C
Viscosity at 40 °C	D 445	0.013 - 0.046 cSt	0.156 cSt
Cetane Index	D 976	2	1.183
Aromatics %	D 1319	1.5-3.3%	1.9%
Cloud Point	D 2500	4 °C	5.8 °C
Freeze Point	D 5972	.80 °C	0.75 °C
Net Heat of Combustion	D 4809	0.046 MJ/kg	0.098 MJ/kg
Hydrogen Content	D 3343	0.012-0.015%	0.22 %

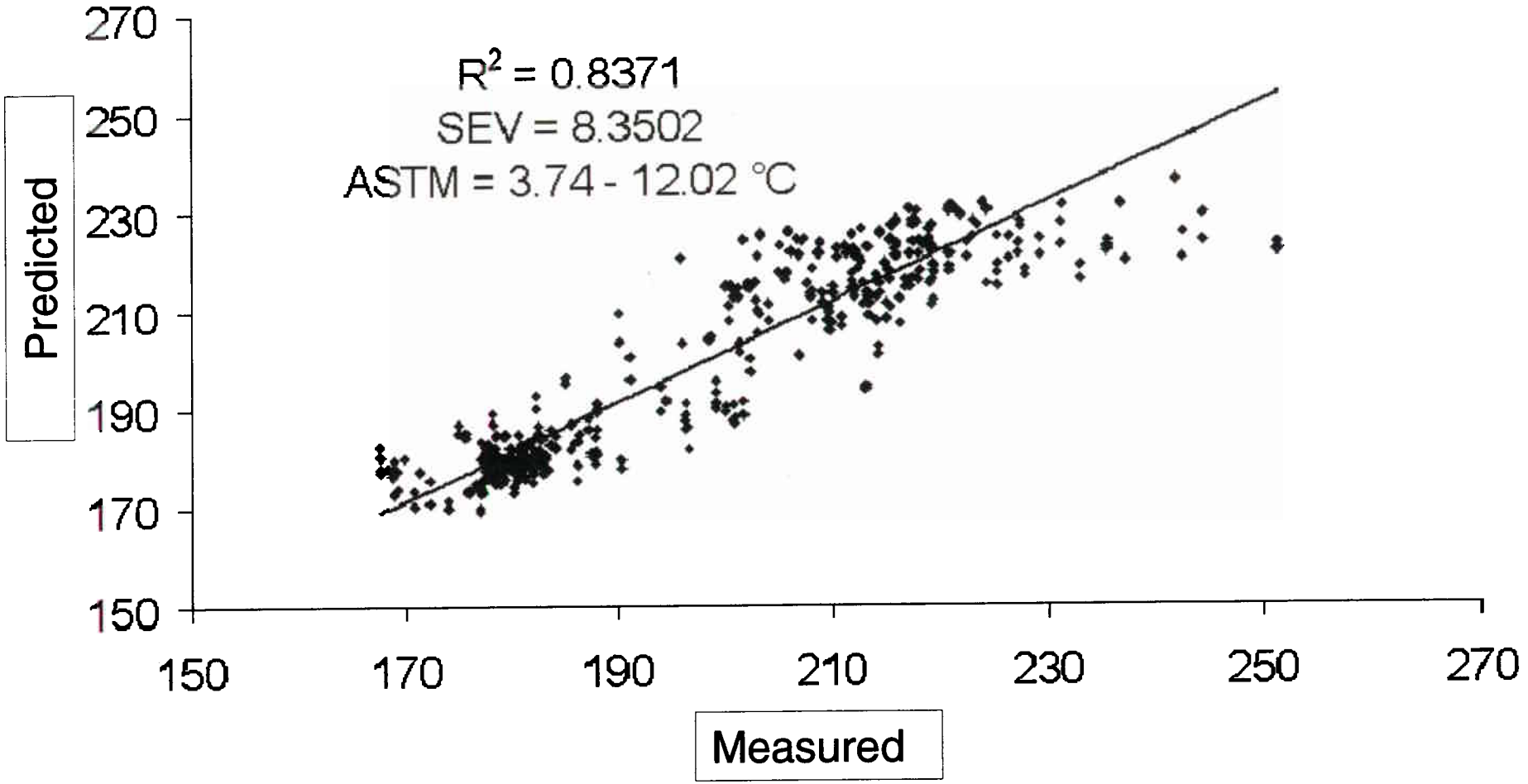
SIMCA



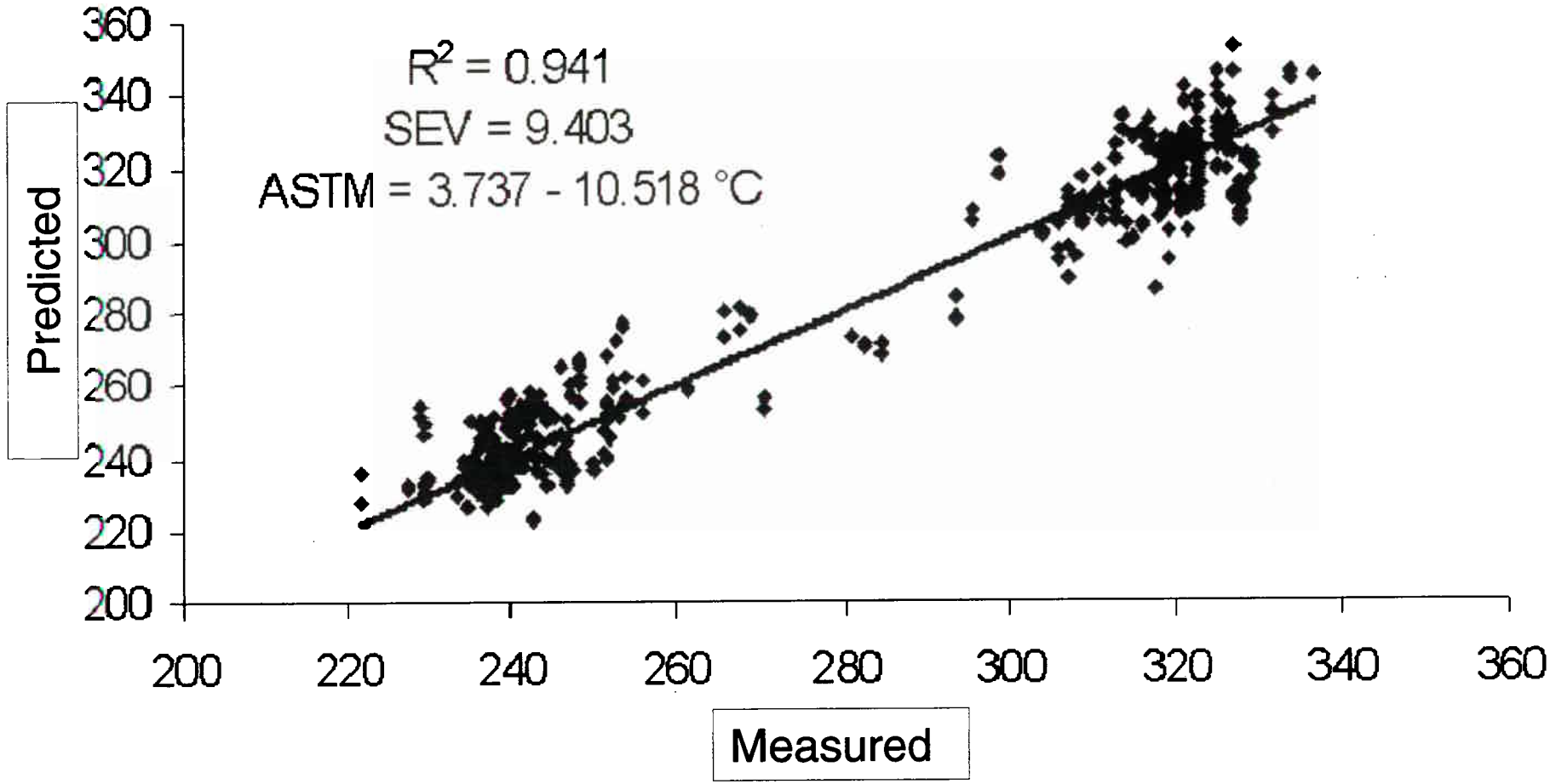
● DIESEL 2

■ JP-8

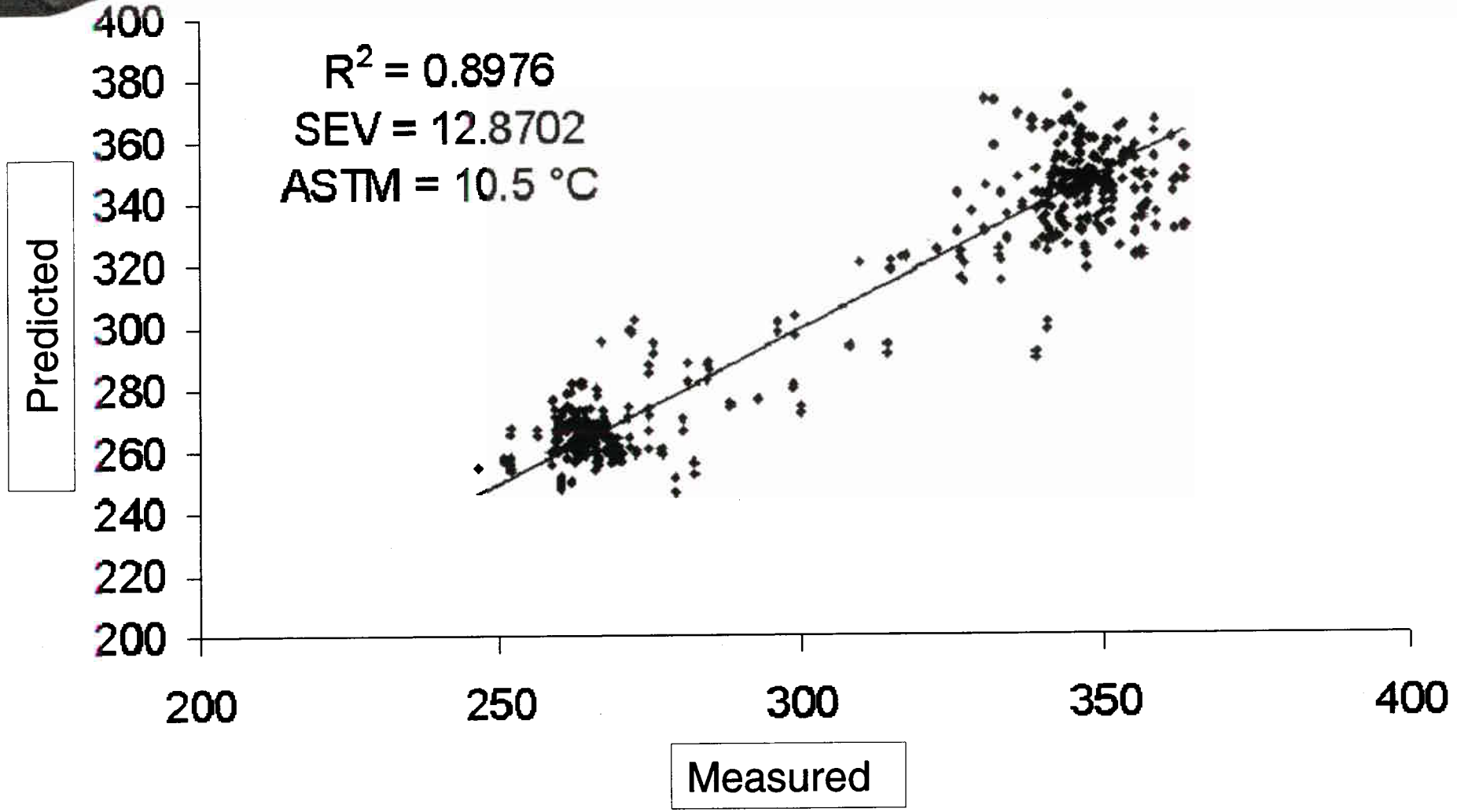
BOILING POINT AT 10% DISTILLED

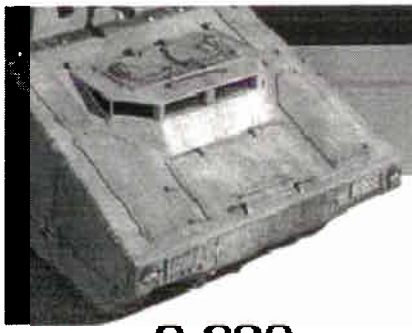


BOILING POINT AT 90% DISTILLED

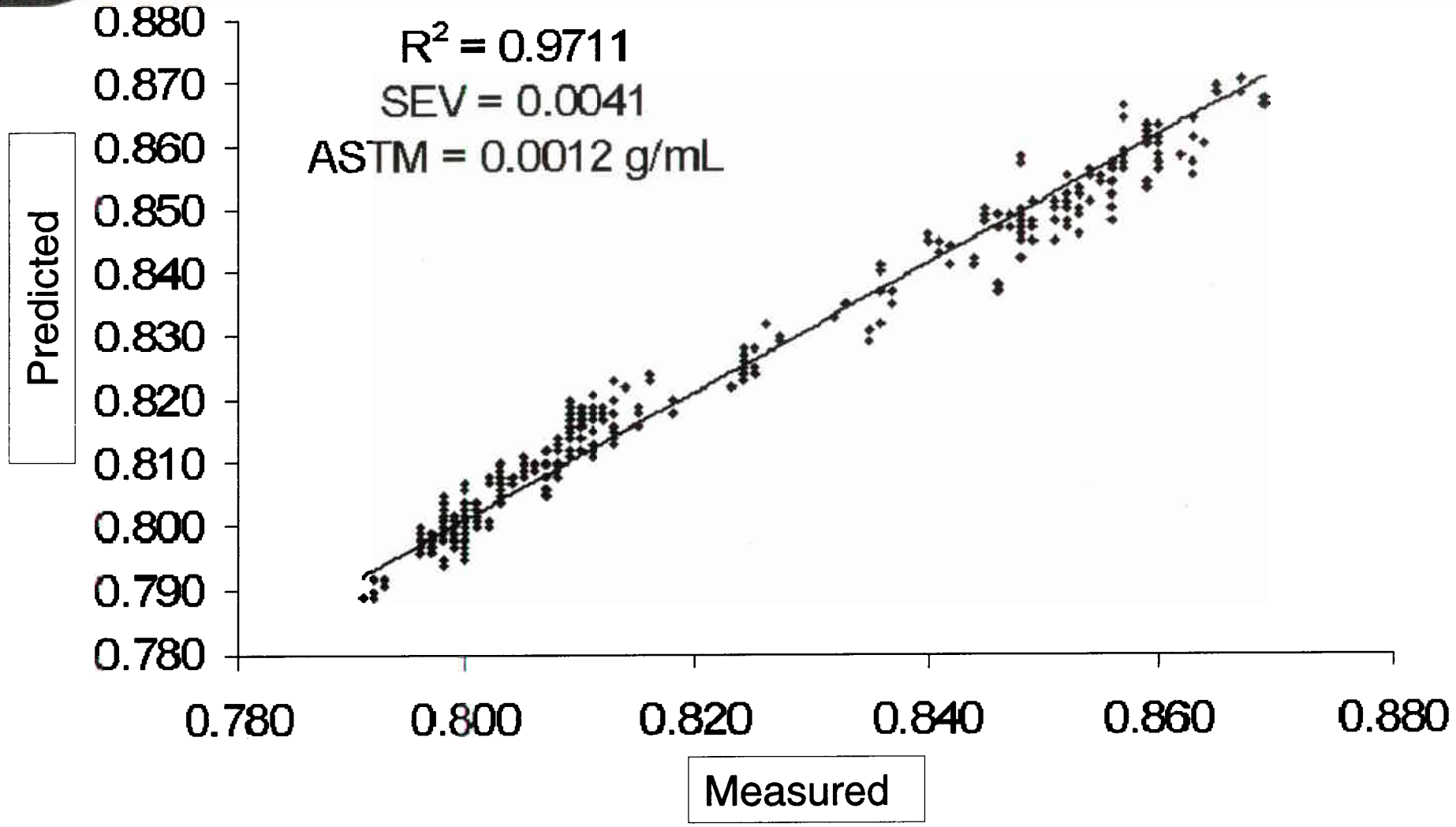


DISTALLATION END POINT

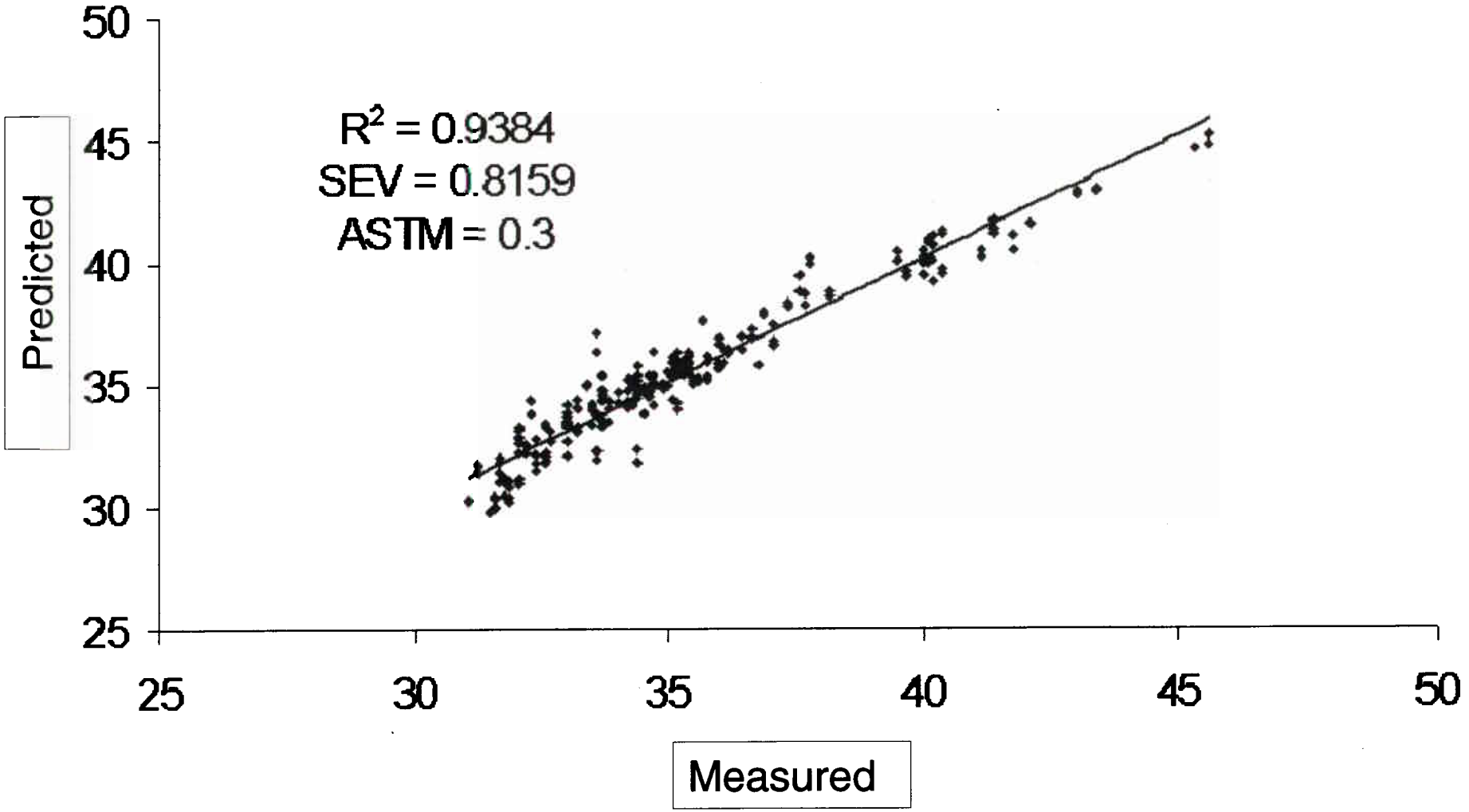




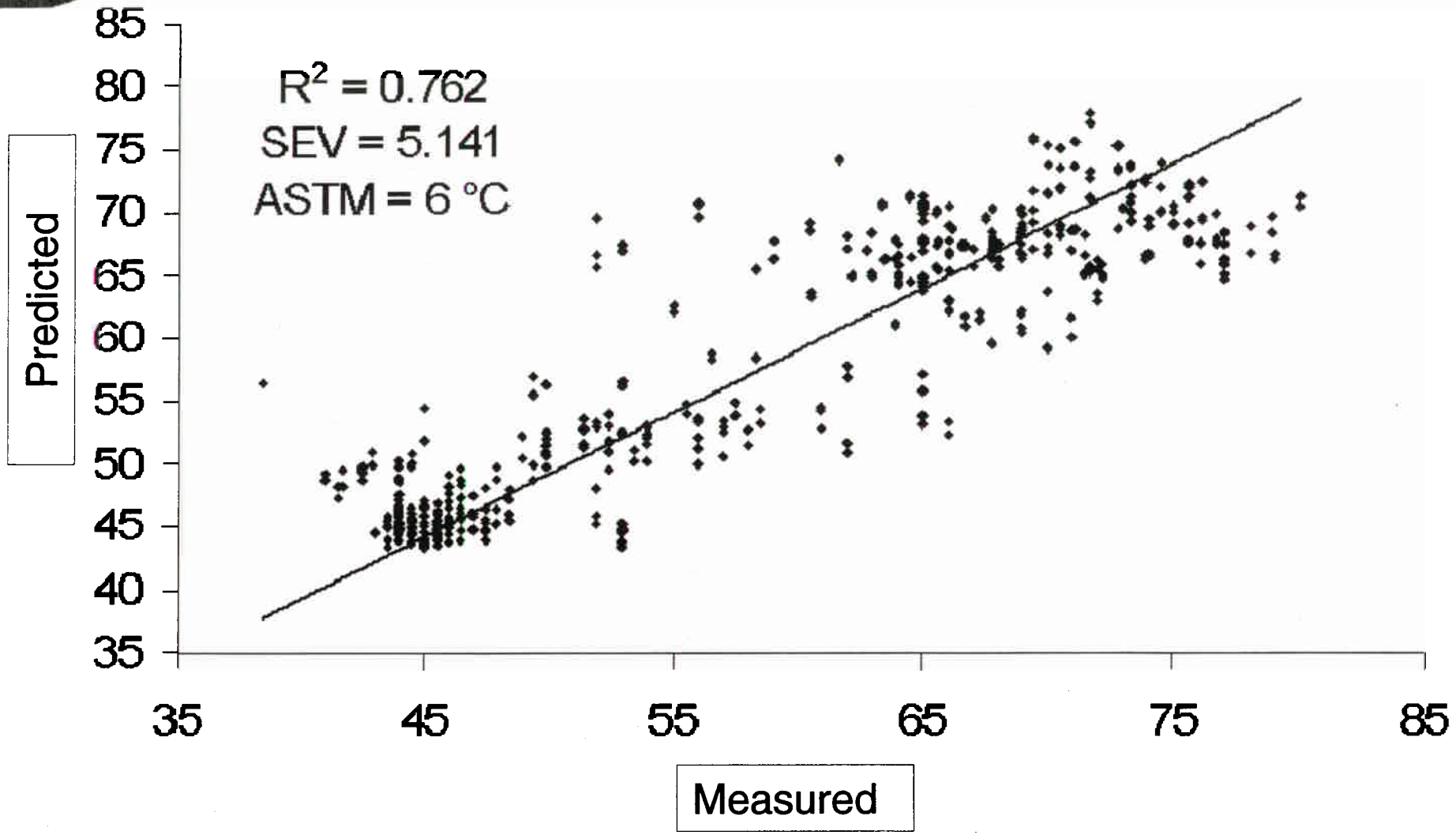
DENSITY


R^2 = 0.9711
SEV = 0.0041
ASTM = 0.0012 g/mL
Predicted
0.880
0.870
0.860
0.850
0.840
0.830
0.820
0.810
0.800
0.790
0.780
0.780
0.800
0.820
0.840
0.860
0.880
Measured

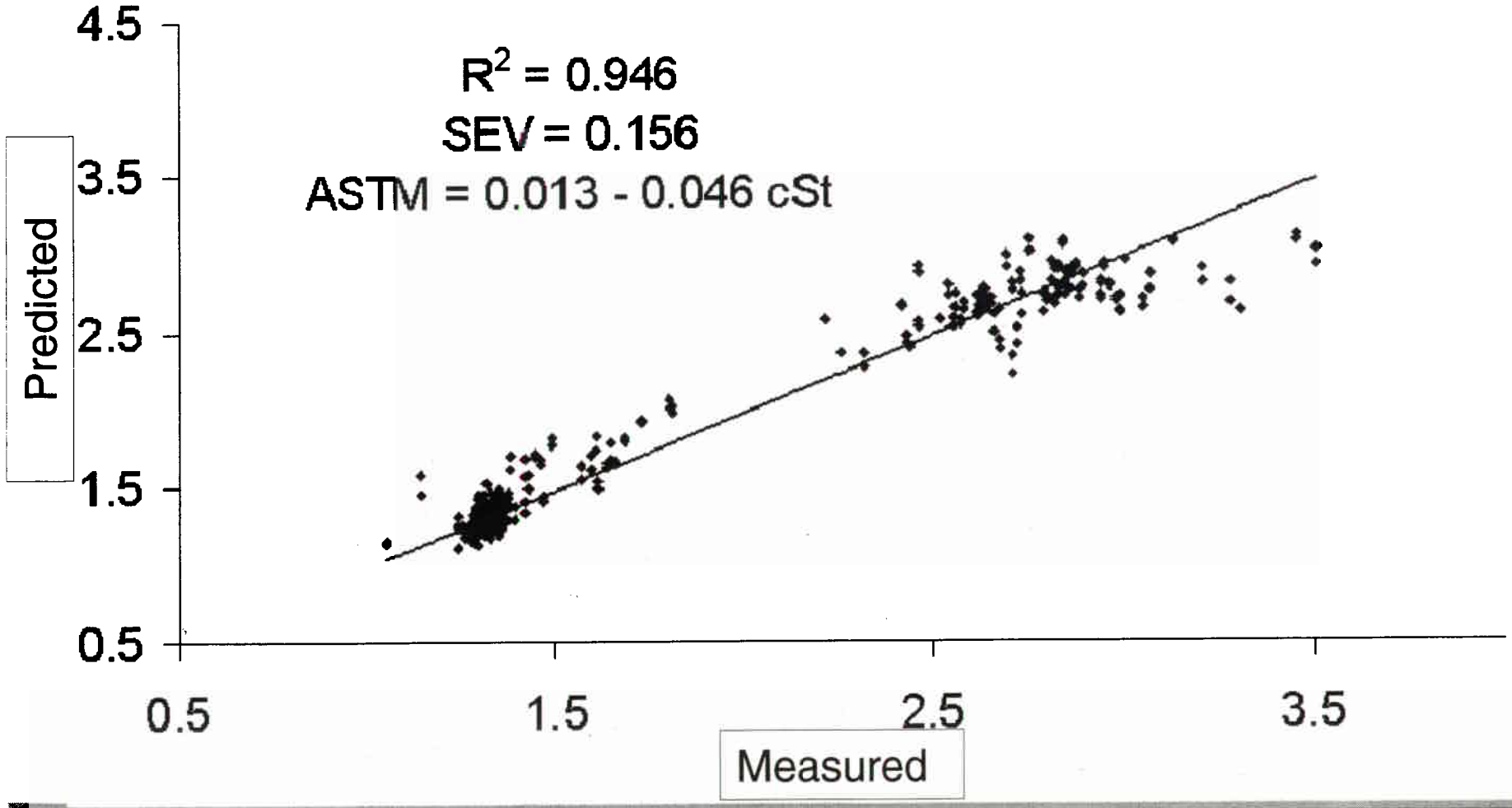
API GRAVITY


R^2 = 0.9384
SEV = 0.8159
ASTM = 0.3
Predicted
50
45
40
35
30
25
25
30
35
40
45
50
Measured

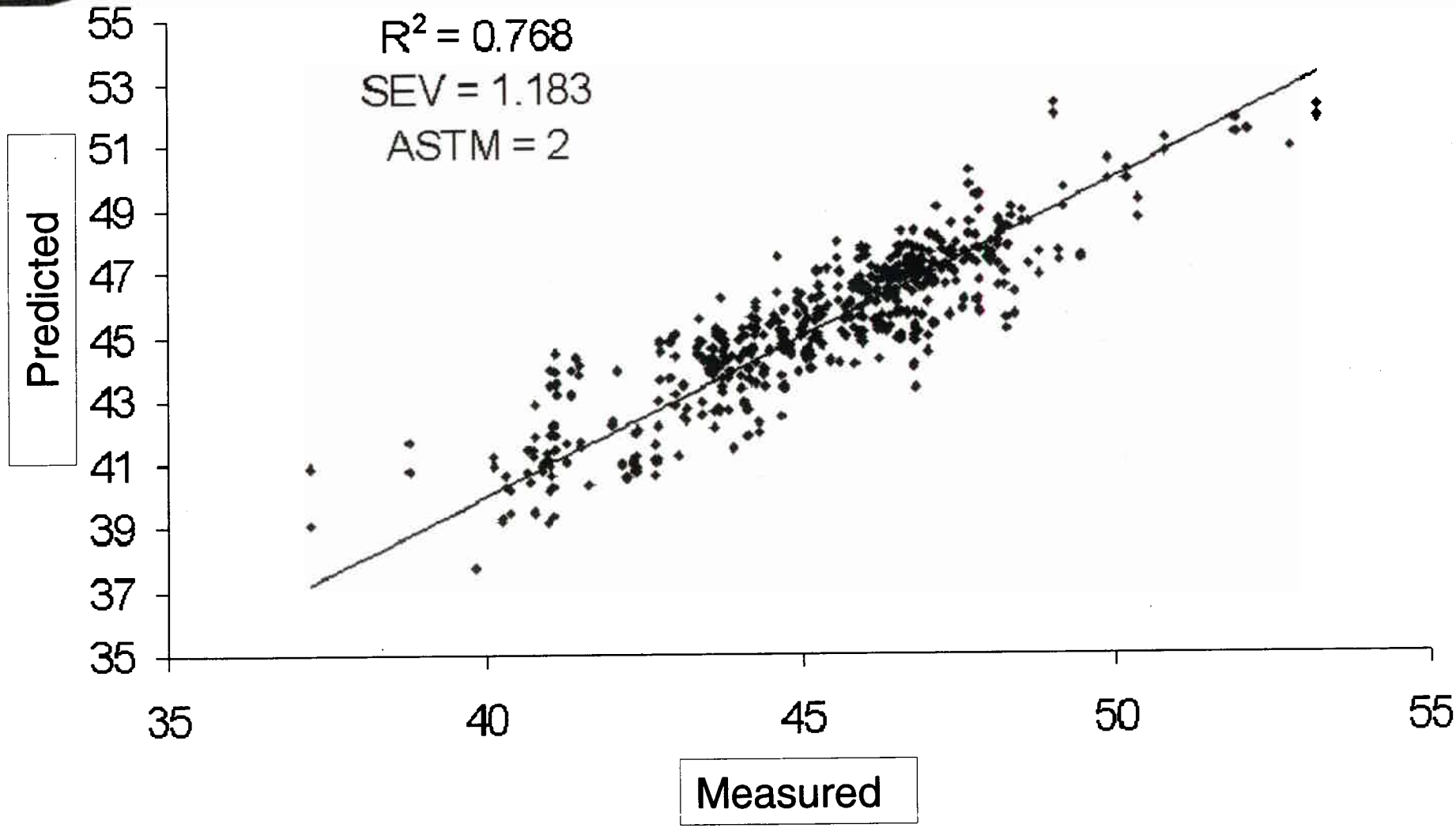
FLASHPOINT °C



VISCOSITY AT 40 °C



CETANE INDEX

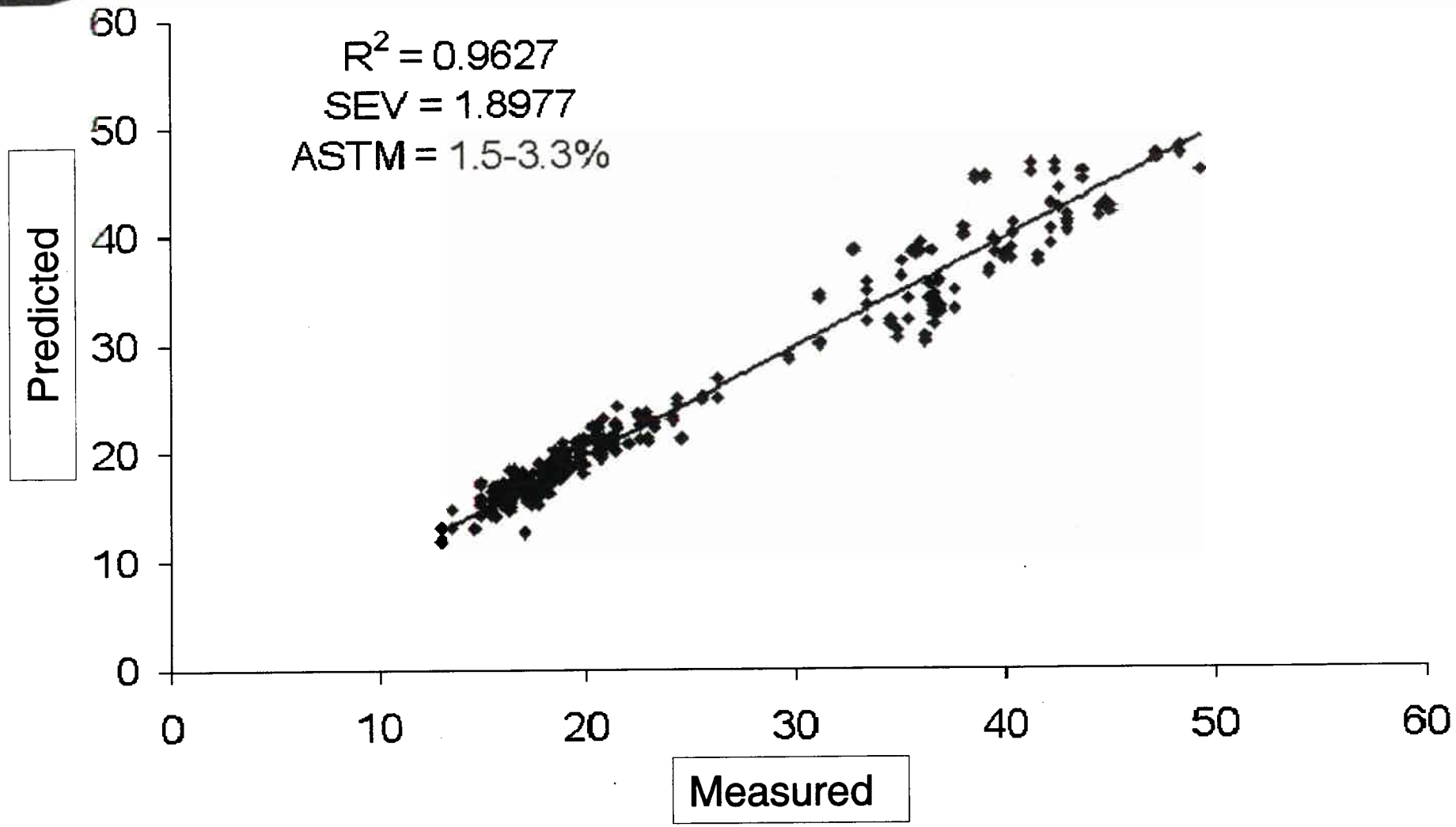


PERCENT AROMATICS

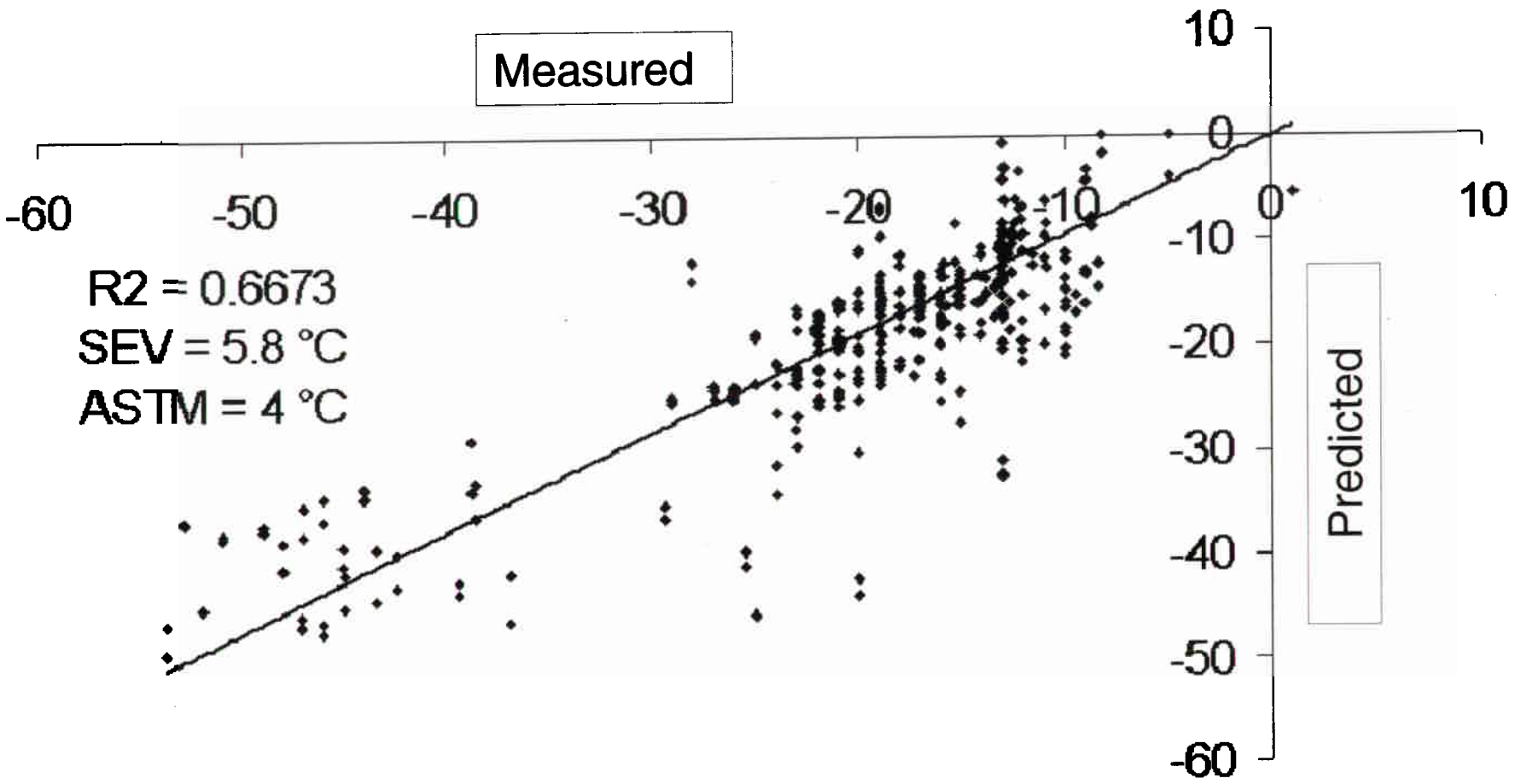
$R^2 = 0.9627$

SEV = 1.8977

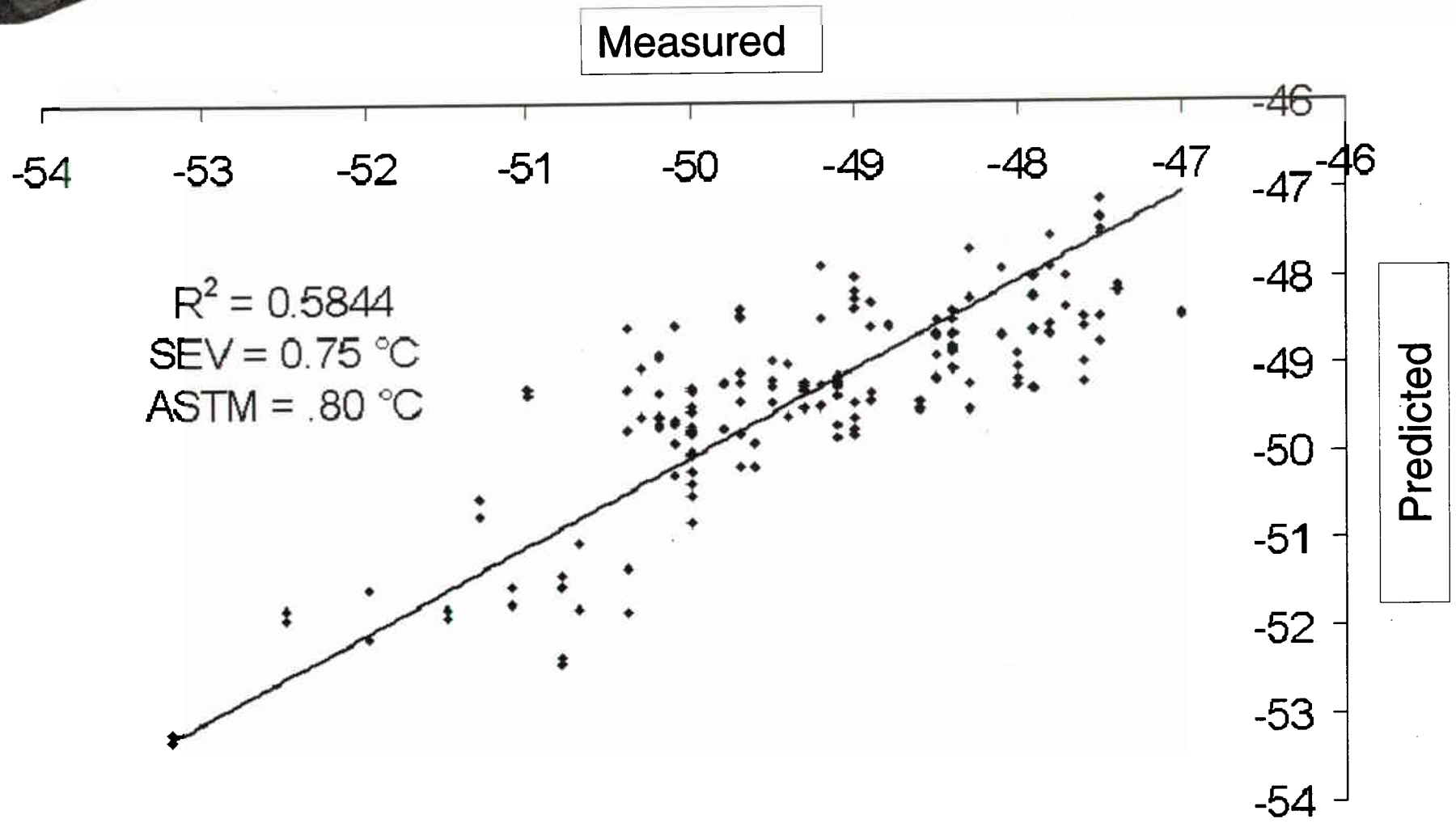
ASTM = 1.5-3.3%



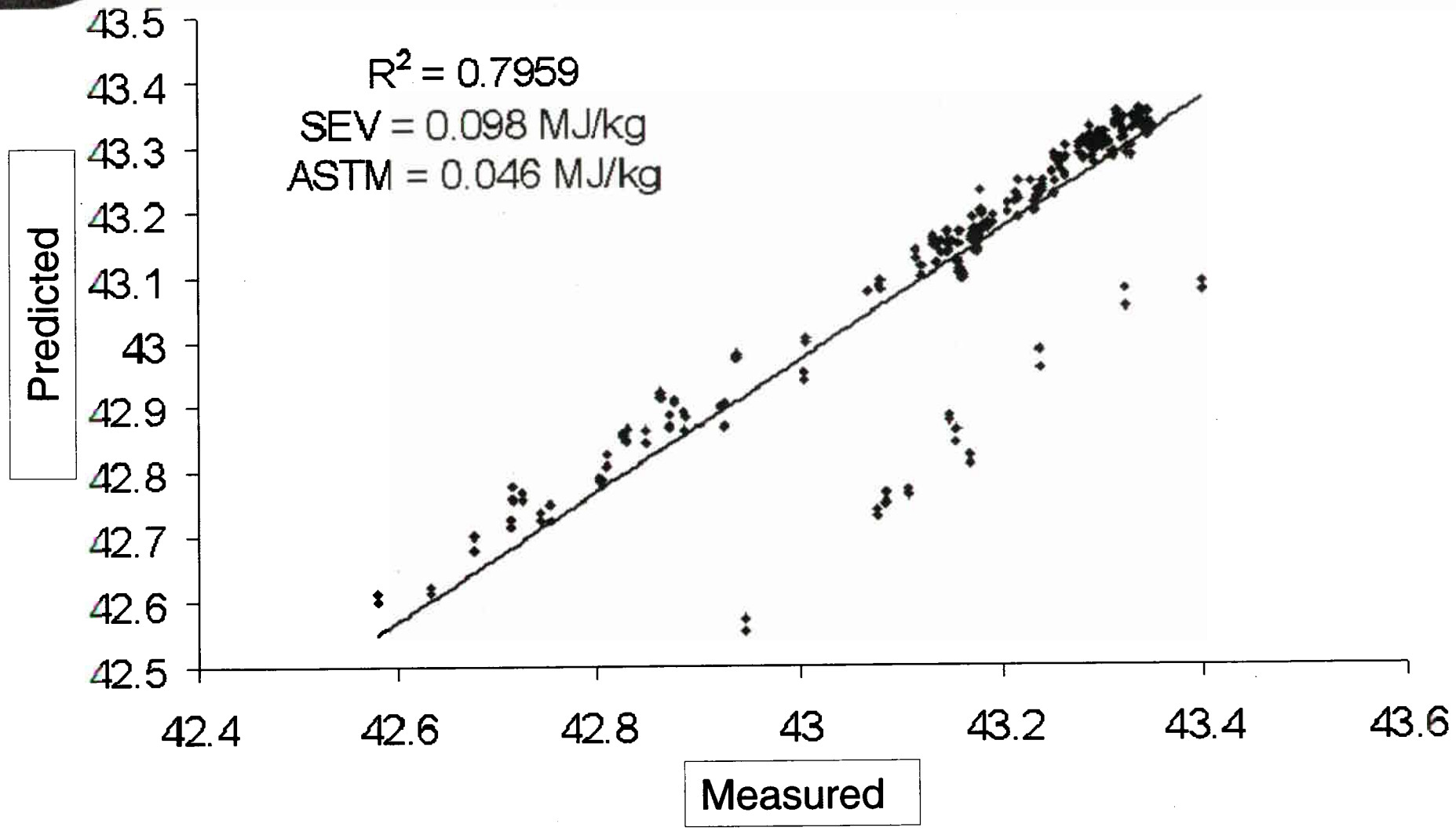
CLOUD POINT


Measured
Predicted
10
0
-10
-20
-30
-40
-50
-60
-60
-50
-40
-30
-20
-10
0
10
R2 = 0.6673
SEV = 5.8 °C
ASTM = 4 °C

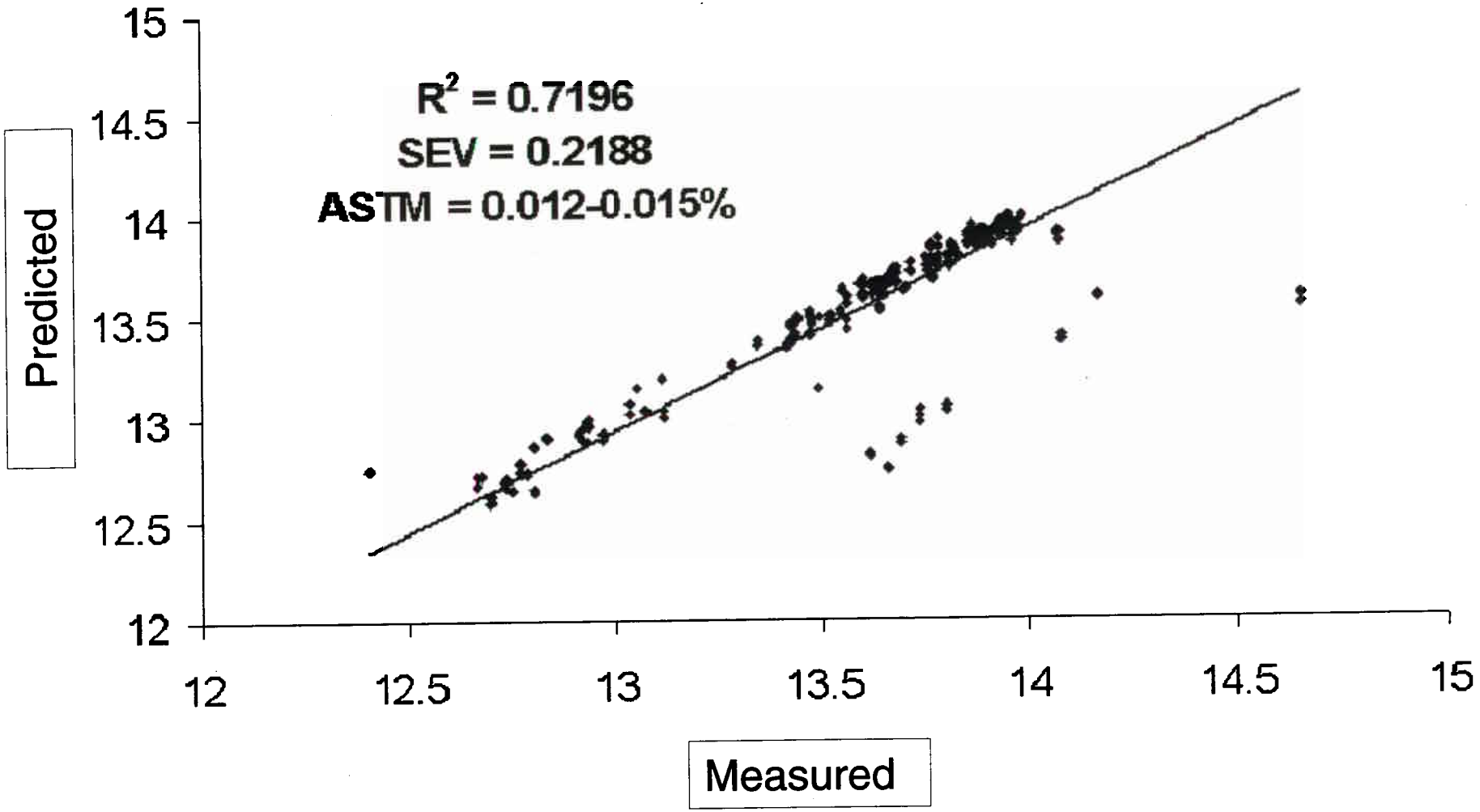
FREEZE POINT

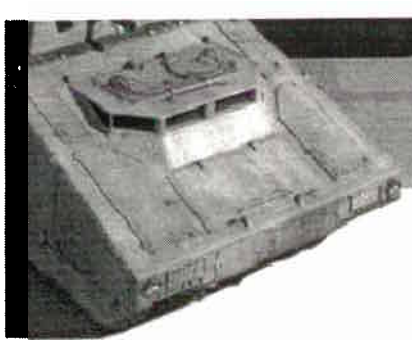


NET HEAT OF COMBUSTION



HYDROGEN CONTENT





TECHNICAL CHALLENGES

Obtaining fuels needed for modeling effort:

- Jet A
- Diesel 1
- JP-5
- Off Specification fuels (procuring or manufacturing)

Improve laboratory results for modeling

- Pour Point
- FSII detection

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From: Harris, Marsha G CONT TARDEC/PraxisCom
Sent: Monday, April 24, 2006 10:03 AM
To: Schmitigal, Joel A MR TARDEC
Subject: #15772 TIC REGISTRATION CONFIRMATION - OPSEC STARTED

Joel:

We received your publication and have registered it as follows:

TIC Registration Confirmation

REG#	Monitoring Name	TITLE
15772	SCHMITIGAL	NEAR-INFRARED FUEL ANALYSIS

Record this number for you proof of accomplishment. Also, put this number in the subject line of any email regarding this publication.

We have initiated the OPSEC Process and will forward a PDF copy of the OPSEC certification when the process is complete.

If you have any questions please contact the TIC @ 45377.

Marsha

Marsha Harris, Contracted Coordinator TARDEC Technical Information Center

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Thank you for your patronage. Please send all OPSEC inquiries to the TIC e-mail listed in outlook. Messages sent to our TIC mailbox can be accessed by both Marsha Harris and Elizabeth Bennett. Your utilization of our TIC mailbox will allow requests to be processed immediately.

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